# THREE MODES OF PODCAST AUGMENTED INSTRUCTION AND PRE-SERVICE PHYSICS TEACHERS' COGNITIVE LEARNING OUTCOMES IN COLLEGES OF EDUCATION IN NORTH-CENTRAL, NIGERIA

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## Abstract
*This study examined three modes of podcast augmented instruction and pre-service Physics teachers' achievement, and retention in Colleges of Education in North-Central, Nigeria. It was a pretest, posttest and delayed posttest and quasi experimental research using 4x2 factorial design. Three hundred and sixty-three students from intact Physics classes in four Colleges of Education were selected from two clusters based on convenience and substantial population, and were used as the sample for the study. The study answered three research questions and tested three hypotheses. Thermal Physics lessons were delivered as classroom lecture. Audio, Enhanced and Video podcast lessons on same content were published online and broadcasted as augmented instructions. Thermal Physics Achievement Test and Thermal Physics Retention Test were used as data collection instruments. The reliability coefficient of the test instruments was 0.78. The data collected were analyzed based on the research question and hypotheses using mean and MANCOVA in SPSS. The result revealed that students taught Physics using Video Podcast Augmented Instruction and Audio Podcast Augmented Instruction achieved better than their counterpart taught using Enhanced Podcast Augmented Instruction or Classroom Lecture Only groups. It also revealed gender had significant effect on the achievement of the students taught using Podcast Augmented Instruction. It is recommended that the use of podcast (audio, enhanced and video) should be encouraged in our higher institution in Nigeria with special consideration for video podcast in practical oriented courses.*

Keywords: E-learning, M-learning, U- Learning, Physics, Cognitive Learning Outcomes Podcast and Gender.

## Introduction
There is virtually no sector of life that has not experienced technological paradigm shift from conventional to digital, ranging from e-banking to e-health, to e-commerce, to e-governance and then to our own constituency which is education that has e-learning. In the recent times, education has experienced technological advancement which has created new ways for teaching and learning. Educators are adopting various ways to communicate effectively with learners in the language they understand best. Many educational institutions are using virtual learning environment and incorporating e-learning into their traditional methods of teaching as part of blended or hybrid learning approach.

E-learning approach allows learners to choose when and how they study. It allows learners to have access to learning materials again and again. Many researchers have reported that the e-learning is a better approach to embark upon for meaningful teaching than traditional lectures (Balogun, 2010). M-learning inherits e-learning advantages over traditional lectures, but extends its reach by making use of potable wireless technologies. Devices such as digital media player, smart phone and personal digital assistants that could be used for m-learning come in handy and can be accessed anytime even while travelling on transport or waiting in

an office. Learners can make better advantages of their unexpected free time using these portable devices to learn. U-learning is the term best used to describe the pervasive nature of modern day learning. The anywhere, anytime, anyhow characteristics of some technologies transcend m-learning. Consequently, increased attention is being given to the adoption of Web 2.0 technologies as digital tools to communicate with the students and delivery platforms for educational contents.

Education is an inevitable tool for sustainable development and a vehicle for advancing the frontier of knowledge. Making education relevant is a matter of ensuring that it generates, informs and maintains the student's vision of life including his professional activities (Okemakinde *et al.*, 2013). According to the Federal Republic of Nigeria (2004) in National Policy on Education, education shall continue to be highly rated in the national development plans because it is the most important instrument of change, and that quality of education at all levels should be geared towards inculcating acquisition of competencies necessary for self-reliance among others. Science and technology education is needed to prevent waste of human labour. The importance of science and technology to national development in the life of our country cannot be overemphasized.

If there is any field of human endeavour where technology advances rapidly in Nigeria today, it is the physical sciences. Most technological changes in Industrial sector ranging from designing and manufacturing of machines, computers, safety and appliances, medical equipment among others depend largely on Physics. Physics is the study of matter, energy, and the interaction between them. Physics is the science that ask the question 'how' about things that happen. The importance of this branch of science has made it necessary for it to be included (at its different depths) in the country's education curriculum at all levels as either science or applied science (technology) education. Olusola and Rotimi (2012) opined that physics is perceived as a difficult course for student from secondary school to university and also for adults in graduate education, and it is well known that both high school and college students find Physics difficult. Adeyemo (2010) explained that it is perceived to be a difficult course because of its abstract nature. This problem actually needs to be urgently addressed if the desired result in Physics education is to be achieved.

To promote continuity in science and technology education, the country needs qualified, competent and committed teachers in our learning institutions. It is a popular saying that no nation can progress beyond its level of educational system and quality of teachers, this shows that teacher education "as in that of colleges of education" is a foundational factor in national technological advancement. Teaching effectiveness is brought about through various components which include; broad based knowledge of the subject matter, effective use of delivery media, good language and communication skills; well organised learning environment and formulation of clear objective (Balogun, 2010). Hence, it is very necessary to look into ways to improve the teaching and learning processes in the teacher education institutions such as Colleges of Education by taking advantages of the emerging technologies.

One of the factors that are crucial for functional science and technology education is that the trainee must be ready to receive and retain what he or she has been taught. Memory retention is a major component of learning (Adeagbo, 2014). Memory retention is the ability to encode, store, retain and recall information in human brain. The ability to retain and retrieve previously learnt content is a very important for the newly learnt content to be well understood and become knowledge. Cognitive learning outcome is regarded as the achievement and retention of contents taught in a lesson. According to Aziz *et al*. (2014), researches on physics education have shown that students have abundant difficulties in

achieving and retaining contents in all topics of Physics, and particularly in the concepts of thermodynamics; despite its importance in day to day living.

In the international context, increasing attention is being given to the use of digital tools to communicate with students as delivery medium for educational contents. Podcast is one of the platforms that could be considered for communicating these contents; as it has very high consumption rate among all ages and both gender in the population (Edison, 2015).

Podcast is a means of publishing and broadcasting audio, slides and video educational content on the web as a one-time production or series of episodes with a common theme. These episodes are published and broadcasted through files that are called rich-site summary (RSS) feeds. The distribution technology used for a podcast is what distinguishes it from other forms of digital audio or video files on the internet (Nie *et al.* 2010).

There are three common types of podcast identified as audio-only, enhanced, and video. (Brown et al., 2009)

(i) The audio-only podcast (Podcast) is an audio delivery format created using voice recorder or Audacity.
(ii) Enhanced podcast (Screencast) is a combination of audio and visuals such as slides, images or graphics. It is in form of presentation with narration and chapters,
(iii) Video podcast (Vodcast) is created using digital camcorder and video editing software such as iMovie.

Podcast audience are to subscribe to the series in order to receive episodes automatically, which makes podcasting different from simply posting files on the web. Podcast can be downloaded to a desktop, laptop and handheld devices.

Gender, which is a major factor in science and technology education participation, plays an important role in its implementation. Aderemi et al., (2013) agreed that women trained in science and technology education, though an important potential resource, are under recognized. Ellis, (2014) stated that developed countries are really making effort to engage more female in science and technology careers for economic reasons and others such as utilization of talent, equality of access, job satisfaction and relative employment stability, while gender bias is still very prevalent (Arigbabu & Mji, 2004). However, in this era of reform in Nigeria, the issue of gender disparity in science and technology education needs to be addressed and given utmost priority. This is to ensure equal participation in this area of our educational sector so that Nigerians can compete favourably in any part of the world, irrespective of their gender (Akpotohwo & Ehimen, 2014). Many researchers are still of the opinion that there are significant differences in the cognitive, affective and psychomotor skill achievements of students in favour of male Ballah and Ugwumba (2015) and Balogun (2010), have actually shown that male students performed better than female counterparts in science and technology subjects. On the contrary, Anagbogu and Eezeliora (2007) exposed students to different scientific training based on cognitive, affective and psychomotor skills and found that girls scored significantly higher than boys. Meanwhile, Balogun (2014) and Gambari et al. (2014), Gambari et al. (2015) discovered no significant difference in the performance of male and female student taught basic technology no matter the medium of delivery.

In Nigeria today, social media like Facebook, twitter, instagram, telegram, whatsapp, chaton, snapchat, palmchat, podcast, BBM, 2go and others have negative impact on the new-generation (digital natives) students and also make them socially isolated. These social media impede them from being able to focus and pay attention to what they want to learn.

To address this problem, educators need to rethink on how they can actually communicate to them effectively. The social media, if properly channelled, could be used in communicating educational contents across to these students.

Podcasting is a fairly new endeavour, so there are relatively few formal evaluations of its educational value at this point in time. Most papers to date are optimistically speculative about the potential impact of podcasting on the quality of educational outcomes and experience, but a handful of authors are much more cautious about the expectations that certain types of podcasting might establish (Deal, 2007).

The importance of Physics concepts especially Thermal Physics in the application of science in daily life activities can never be over emphasised. The difficulties of understanding the contents continue even after students have successfully completed relevant coursework. There is a great need to urgently address this using media that could actually ensure contents' retention for the country to have competent Physics graduates that can demonstrate mastery of contents in the field of work, in the industries or as teachers that will pass the contents to others.

However, in this era of reform in Nigeria, the issue of gender disparity in science and technology education is still very prevalent and needs to be addressed and given utmost priority. This is to ensure equal participation in this area of our educational sector so that Nigerians can compete favourably in any parts of the world, irrespective of their gender (Akpotohwo & Ehimen, 2014). Aguele and Agwugah (2008) are still of the opinion that there are significant differences in the cognitive, affective and psychomotor skill achievements of students in favour of male. Balogun (2010) has actually shown that male students performed better than female counterparts in science and technology related subjects. On the contrary, Gambari (2010), Gambari *et al.* (2014), Balogun (2014), Gambari *et al.* (2015) discovered no significant difference in the performance of male and female student taught basic technology no matter the medium of delivery.

Many researchers are still of the opinion that gender stereotype is something to be worried about in science and technology education, while others see it as an issue of the past. Some are of the view that despite the attention given to the female students in science and technology, there is still wide gap in the ratio of male to female in the world of work while others agreed that the relative strength of the stereotypes varies across different science and technology courses. Consequently, gender disparity in scientific and technology education still needs to be further addressed and given utmost priority in order to ensure equal opportunity. This would allow every Nigeria citizen irrespective of gender to compete favourably in any parts of the world. In view of the difference in opinion of researchers, it is necessary for more researches to be carried out on gender involvement in science and technology.

In several reviews, studies comparing the effects of audio, enhanced and video podcasts are very scarce. In addition, variables such as gender and cognitive learning outcomes (achievement and retention) of pre-service teachers exposed to podcast augmented instructions in colleges of education make this a unique study. With all these in mind, it is therefore necessary to carry out this study.

## Objective of the Study

The objective of the study is to determine the effects of podcast augmented learning and influence of gender on students' cognitive learning outcomes in Physics.

## Research Questions

(i) What is the difference in the mean achievement and retention scores of Physics students taught using Classroom Lecture Only (CLO), Audio Podcast Augmented Instruction (APAI), Enhanced Podcast Augmented Instruction (EPAI) and Visual Podcast Augmented Instruction (VPAI)?

(ii) What is the difference in the mean achievement and retention scores of male and female Physics students taught using podcast augmented instruction?

## Research Hypotheses

(i) There is no significant difference in the mean cognitive learning outcomes (posttest and retention scores) of Physics students taught using audio Podcast Augmented Instruction (APAI), Enhanced Podcast Augmented Instruction (EPAL), Video Podcast Augmented Instruction (VPAI) and Classroom Lecture Only (CLO).

(ii) There is no significant difference in the mean cognitive learning outcomes (posttest and retention scores) of male and female Physics students taught using Podcast Augmented Instruction (APAI).

## Methodology

The study adopted a quasi-experimental design, that is, a pretest-posttest, control group design modified to accommodate delayed posttest to test retention and a moderating variable (Gender). The treatment variable had four levels of independent variable (three experimental and one control), while the moderating variable had two levels of gender (male and female). The dependent variable (cognitive learning outcomes) had the achievement and retention scores.

Students in all the groups (experimental and control) were given pre-test before the treatment using Thermal Physics Achievement Test (TPAT). Students in experimental group 1 were exposed to Classroom Lecture and augmented with Audio Podcast Instruction (APAI); students in experimental group 2 were exposed to Classroom Lecture and augmented with Enhanced Podcast Instruction (EPAI), and students in experimental group 3 were exposed to Classroom Lecture and augmented with Video Podcast Instruction (VPAI), while the students in control group were exposed to Classroom Lecture only (CLO). The post-test was administered on the students in all the groups after the four weeks treatment and retention test was administered after six weeks. The research design layout is as shown in Table 1

Table 1: Research Design Layout

| Group | Pre-test | Treatment | Moderating Variables | Post-test | Retention test |
|---|---|---|---|---|---|
| Experimental Group I | $O_1$ | APAI ($X_1$) | Gender | $O_2$ | $O_3$ |
| Experimental Group II | $O_1$ | EPAI ($X_2$) | Gender | $O_2$ | $O_3$ |
| Experimental Group III | $O_1$ | VPAI($X_3$) | Gender | $O_2$ | $O_3$ |
| Control Group | $O_1$ | CLO($X_4$) | Gender | $O_2$ | $O_3$ |

The population of the Study comprised all the 3,436 Physics Education Students in the fourteen (14) Federal and State Government owned Colleges of Education in the six North-Central States (Benue, Kogi, Kwara, Nasarawa, Niger & Plateau) and Federal Capital Territory Abuja in Nigeria (NCCE Digest, 2016). The six states were grouped into two clusters (A and B) based on their location. Benue, Plateau and Nasarawa states are in

Cluster A and Kwara, Kogi and Niger States are in Cluster B. The target population in these Colleges of Education were the NCE I Physics students. This is because the course content to be taught (Thermal Physics I) was meant for that level.

The study was conducted using 363 NCE I students in the Physics Departments in Colleges of Education that have School of Science with Physics option in any of the combined course such as Mathematics/Physics, Chemistry/Physics, Biology/Physics, Integrated Science/Physics, Geography/Physics and Computer/Physics. Two Colleges of Education were purposively selected from each cluster based on convenience and substantial population of Physics students in these colleges; this is to ensure realisation of adequate sample size and representation of the geopolitical zone. Students in intact Thermal Physics I classes comprising of male and female students in NCE I classes of the selected colleges that have access to smart phones or computers were used as sample for the study. Students from one of the selected Colleges (intact Thermal Physics I class) were used for control group, while Students from others elected Colleges in their intact Thermal Physics I classes were used for experimental groups I, II and III. The gender of all the students in the study was considered. The distribution of sample for the study is shown in Table 2.

Table 2: Distribution of Sample for the Study

| Group | Male | Female | Total |
|---|---|---|---|
| 1. Audio Podcast Augmented Instruction | 53 | 21 | 74 |
| 2. Enhanced Podcast Augmented Instruction | 48 | 44 | 92 |
| 3. Video Podcast Augmented Instruction | 89 | 23 | 112 |
| 4. Classroom Lecture Only | 61 | 24 | 85 |

From Table 2, the groups comprised a total of 363 students; experimental group 1 (comprising 74 students) was exposed to classroom lectures and augmented with audio podcast instruction, ; experimental group 2 (comprising 92 students) was exposed to classroom lectures and augmented with enhanced podcast instruction, while experimental group 3 (comprising of 112 students) was exposed to classroom lectures and augmented with video podcast instruction and control group (comprising of 85 students) was exposed to classroom lecture only.

## Research Instruments

Different episodes of audio, enhanced and video podcast on Thermal Physics contents were published online and broadcasted to students in experimental group 1, 2 and 3 respectively after each of the four classroom lessons.

The instruments that were used in collecting data for the study were researcher developed Thermal Physics Achievement Test (TPAT) and Thermal Physics Retention Test (TPRT). TPAT and TPRT consisted of two sections; section 1 elicited students' data such as gender and group (delivery medium) and section 2 consists of 50 multiple choice test items with four options (A-D). The instruments were validated by two Physics lecturers from Colleges of Education and two lecturers from Science Education (Physics) Department and Educational Technology Department in the School of Science and Technology Education, Federal University of Technology (FUT), Minna. The reliability coefficient of the TPAT and TPRT was 0.78.

The study was for six weeks. Pretest was administered to all the students in the study. The four groups were taught for four weeks using conventional method, and concurrently exposed the three experimental groups to the treatments. Thereafter Thermal Physics

Achievement Test (TPAT) was administered to measure the achievements of the students in each of the groups. Thermal Physics Retention Test (TPRT) was also administered after two weeks to measure the retention of the students in the groups. The scores were obtained and the data were analysed based on the stated hypotheses.

Mean analysis was used to answer the research questions. Graphical representations were also used to support the results for easy interpretation where necessary. MANCOVA was used to analyse the hypotheses as it was established that the pretest had significant effect on the achievement, and the achievement and retention are of linear relationship. Where there are differences, Sidak analysis was used to locate the directions. The results are presented in line with the formulated research questions and hypotheses:

## Results

Research Question One: What is the difference in the mean achievement and retention scores of Physics students taught using Classroom Lecture Only (CLO), Audio Podcast Augmented Instruction (APAI), Enhanced Podcast Augmented Instruction (EPAI) and Visual Podcast Augmented Instruction (VPAI)?

To show the improvement in learning after treatment, the mean gain score (differences between pretest and posttest mean scores) and mean decay scores ((differences between posttest mean scores and retention mean scores) of the groups (CLO, APAI, EPAI and VPAI) are as shown in Table 3.

Table 3: Mean Gain Scores and Mean Decay Scores of Students Taught Physics Using CLO, APAI, EPAI and VPAI

| Group | Pretest | Posttest | Retention Test | Mean Gain Score | Mean Difference |
|---|---|---|---|---|---|
| APAI | 21.5946 | 41.4595 | 35.5946 | 19.8649 | 5.8649 |
| EPAI | 20.5870 | 40.1848 | 34.3696 | 19.5978 | 5.8152 |
| VPAI | 19.6696 | 40.4375 | 34.5625 | 20.7679 | 5.8750 |
| CLO | 19.1294 | 38.5412 | 32.8353 | 19.4118 | 5.0706 |

From Table 3, it was observed that all the groups benefited equally from the treatment as shown in the Mean Gain and Mean Decay Score. For instance, VPAI had highest mean gain and mean decay scores of 20.7679 and 5.875 respectively; followed by APAI with the mean gain and mean decay scores of 19.8649 and 5.8649. EPAI had mean gain and mean decay scores of 19.5978 and 5.8152 respectively while the CLO had the least mean gain and mean decay scores of 19.4118 and 5.0706. The graphical representation of the student performances is illustrated in Figure 1.

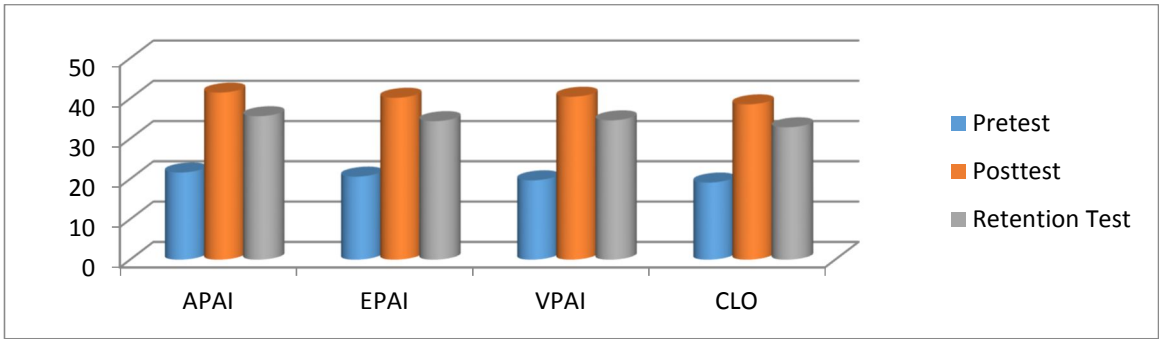


Figure 1: Performances of Physics Students Taught Using CLO, APAI, EPAI and VPAI

Research Question Two: What is the difference in the mean achievement and retention scores of male and female Physics students taught using podcast augmented instruction?
To show the improvement in learning after treatment, the mean gain score (differences between pretest and posttest mean scores) and mean decay scores ((differences between posttest mean scores and retention mean scores) of the groups (male and female) are as shown in Table 4.

Table 4: Mean Gain Scores and Mean Decay Scores of Male and Female Physics Students Taught Using PAI

| Gender | Pretest | Posttest | Retention | Mean Gain Score | Mean Decay Score |
|---|---|---|---|---|---|
| Male | 20.490 | 40.842 | 34.890 | 20.352 | 5.952 |
| Female | 20.477 | 40.159 | 34.296 | 19.682 | 5.863 |

Table 4, it was observed that the male and female Physics students taught using PAI benefited from the treatment irrespective of their gender as shown in the Mean Gain and Mean Decay Score. The table shows that male students had mean gain and mean decay scores of 20.352 and 5.952 respectively, while female students had mean gain and mean decay scores of 19.682 and 5.863 respectively. It also shows that the male students had the higher mean gain score and lower mean decay indicating higher learning and retention rate than the female students in the experimental groups. The graphical representation of the student performances is illustrated in Figure 2.

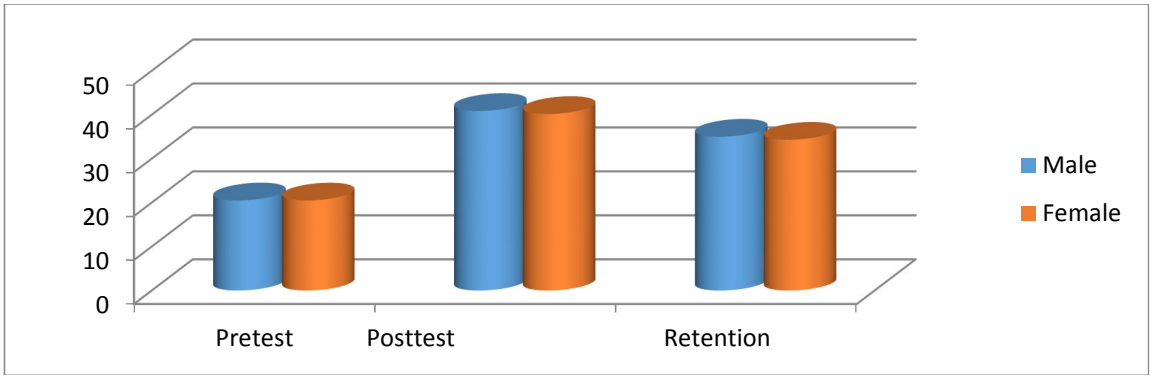


Figure 2: Performances of Male and Female Physics Students Taught Using PAI.

Hypothesis One: There is no significant difference in the mean cognitive learning outcomes (achievement and retention) scores of Physics students taught using CLO, APAI, EPAI and VPAI. Table 5 shows the Multivariate Effect of CLO, APAI, EPAI and VPAI on Posttest and retention test mean scores of Physics students using Pretest as Covariate.

Table 5: Multivariate Analysis of Covariance of Posttest and Retention Test Mean Scores of Physics Students Taught Using CLO, APAI, EPAI and VPAI and Pretest as Covariate

| | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|
| Pillai's trace | 0.085 | 5.305 | 6 | 716 | 0.000 |
| Wilks' lambda | 0.915 | 5.391 | 6 | 714 | 0.000 |
| Hotelling's trace | 0.092 | 5.476 | 6 | 712 | 0.000 |
| Roy's largest root | 0.088 | 10.521 | 3 | 358 | 0.000 |

Table 5 reveals that there was a statistically significant difference among the treatment groups (CLO, APAI, EPAI and VPAI) on combined dependent variables (posttest and retention test score) after controlling for pretest, $F(6, 714) = 5.391$, $p < 0.05$, Wilkis' $\lambda = 0.915$. The results of the analysis indicate that hypothesis one should be rejected on the basis that the multivariate effect of treatment (CLO, APAI, EPAI and VPAI) was a statistically significant on the posttest and retention test mean score when combined. On the basis of this, hypothesis one was rejected. Since it was established that there was a significant difference in the combined posttest and retention test mean scores of the groups, Sidak's post-hoc analysis was done to identify the direction of the difference among the treatment groups as shown in Table 6.

Table 6: Sidak Analysis of Significant Difference on Posttest and Retention Test Mean Scores of Students Taught Using CLO, APAI, EPAI and VPAI

| Dependent Variable | Source | | Mean Difference | Significance (P) | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Posttest | APAI | EPAI | 0.447 | 0.587 | -0.347 | 1.241 |
| | | VPAI | -0.559 | 0.285 | -1.324 | 0.207 |
| | | CLO | 0.894* | 0.023 | 0.079 | 1.709 |
| | EPAI | APAI | -0.447 | 0.587 | -1.241 | 0.347 |
| | | VPAI | -1.006* | 0.001 | -1.721 | -0.291 |
| | | CLO | 0.447 | 0.548 | -0.320 | 1.213 |
| | VPAI | APAI | 0.559 | 0.285 | -0.207 | 1.324 |
| | | EPAI | 1.006* | 0.001 | 0.291 | 1.721 |
| | | CLO | 1.453* | 0.000 | 0.722 | 2.183 |
| | CLO | APAI | -0.894* | 0.023 | -1.709 | -0.079 |
| | | EPAI | -0.447 | 0.548 | -1.213 | 0.320 |
| | | VPAI | -1.453* | 0.000 | -2.183 | -0.722 |

From the Sidak post hoc analysis on posttest and retention test of the groups in Table 6, the following were deduced; In posttest mean score, statistically significant difference was established between of APAI (Group 1) and CLO (Group 4); (mean diff=0.894, $p<0.05$) in favour of APAI (Group 1) with an upper bound of 1.709. There were statistically significant differences in the posttest mean score comparison of VPAI (Group 3) with EPAI (Group 2), and VPAI (Group 2) with CLO (Group 4); (mean diff=1.006 and 1.453 respectively, $p<0.05$) with upper bounds of 1.721and 2.183 respectively, all in favour of Group 3. The analysis also revealed that no statistically significant difference was established in Retention test mean scores.

Hypothesis Two: There is no significant difference in the mean cognitive learning outcome (achievement and retention scores) of male and female Physics students taught using Podcast Augmented Instruction (PAI). Table 7 shows the Multivariate Effect of Gender on Posttest and retention test mean scores of Physics students taught using PAI.

Table 7: Multivariate Analysis of Covariance of Posttest and Retention Test Mean Scores of Male and Female Physics Students Taught Using Podcast Augmented Instruction

| | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|
| Pillai's trace | 0.022 | 3.134a | 2 | 274 | 0.045 |
| Wilks' lambda | 0.978 | 3.134a | 2 | 274 | 0.045 |
| Hotelling's trace | 0.023 | 3.134a | 2 | 274 | 0.045 |
| Roy's largest root | 0.023 | 3.134a | 2 | 274 | 0.045 |

Table 7 reveals that when dependent variables (posttest and retention test score) were combined and pretest controlled, there was a statistically significant difference between male and female Physics students taught using PAI, $F(2, 274) = 3.134$, $p < 0.05$, Wilkis' $\lambda = 0.978$. The results of the analysis indicate that this hypothesis should be rejected on the basis that the multivariate effect of gender was statistically significant on the combined posttest and retention test mean scores of students taught using PAI. On this basis, hypothesis two is therefore rejected. Sidak's post-hoc analysis was done to identify the direction of the difference between male and female students as shown in Table 8.

Table 8: Sidak Analysis of Significant Difference on Posttest and Retention Test Mean Scores of Male and Female Students Taught Using PAI

| Dependent Variable | Source | | Mean Difference | Significance (P) | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Posttest | Male | Female | 0.673* | 0.013 | 0.143 | 1.203 |
| | Female | Male | -0.673* | 0.013 | -1.203 | -0.143 |

From the Sidak post hoc analysis on posttest and retention test of the groups in Table 8, it was established that the posttest mean scores of male and female Physics students taught using PAI had a statistically significant difference in favour of male students; (mean diff=0.673, $p<0.05$) with an upper bound of 1.203. It also shows that the Physics contents taught using PAI were well retained by most students irrespective of their gender

## Discussion

The findings that emanated from this study revealed that there were significant differences in the cognitive learning outcomes of Physics students exposed to APAI, EPAI, VPAI and those exposed to CLO. This is in line with the views of Farshi and Mohammadi (2013), and Farangi et al. (2015) whose research findings are positive regarding the use of podcasts as a teaching and learning tool. The weekly podcast summaries were effective as teaching tool which produced improved student achievement and raised comprehension of course content optimistically. It also shows that podcasts can help to increase student performance and can augment or even replace in-class lectures that students might have had or missed. Students under Vodcasting (VPAI) and Podcasting (APAI) conditions scored higher than the Screencasting (EPAI) or in-class (CLO) condition. Even though the concept of podcasting is relatively new, the sudden interest in podcasting and Vodcasting comes from the numerous uses that the technology promises. All the students benefited from the instructional process but at different rate as also established by the study.

The findings from the study showed that there is a statistically significant difference in the cognitive learning outcome of male and female Physics students taught using PAI. This finding shows that male students benefited more than female students from the lessons delivered using PAI. This is in line with the finding of Ballah and Ugwumba (2015) that there was a significant gender difference in academic performance in favour of the physics male students. It is also in line with the findings of Balogun (2010) that is of the opinion that there are significant differences in the cognitive, affective and psychomotor skill achievements of male and female students in the field of science and technology. This finding is contrary to the findings of Akpotohwo and Ehimen, (2014) who found out Nigerians can compete favourably in any part of the world, irrespective of their gender. The finding is contrary to the findings of Gambari *et al.* (2014), Balogun (2014), Gambari *et al.* (2015), Adegbija and Falode (2014) who discovered no significant difference in the performances of male and female students no matter the medium of delivery. Thus, there

are conflicting results in gender-related researches as studies vary in their learning contexts such as the methodology, populations, geographical location and research tasks.

## Conclusion

The paper has critically examined technological advancement in education with specific emphasis on three modes of podcast (audio, enhanced and video). The study revealed significant differences in the achievement and not the retention of students taught Physics concepts using APAI, EPAI, VPAI or CLO in favour of VPAI and APAI respectively. It also revealed that gender difference is still an issue in the field of sciences. It is the view of the researcher that there is still gap to be bridged in the area of ubiquitous learning (U-learning) especially for abstract or practical related topics in science courses. In practical oriented courses like Physics, it is obvious that the use of audio or enhanced podcast without visuals could not actually deliver the message clearly. Hence, there is need for visual aids in form of video podcast (vodcast) or realia that will show or demonstrate the concepts for the students to practice. Podcast Augmented Instruction gives better opportunities for content learning to male students than their female counterparts, and equal opportunity for content retention.

## Recommendations

Based on the findings that emanated from this study, it is recommended that:

(i) The use of podcast (audio, enhanced and video) for teaching should be encouraged in our institutions of learning for both male and female Physics students.

(ii) Educators should be encouraged to be in the fore front of the digital struggle, to win our students over from the journey of no-return into social media world which impedes them from being able to focus and pay attention to their studies. Educators need to rethink and modify how they teach in other to addressing this problem.

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